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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE PERFORMANCE OF CHILDREN OF DIFFERENT RACES, SEX, AND GEOGRAPHIC AREAS ON SELECTED PIAGET CONSERVATION TASKS

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

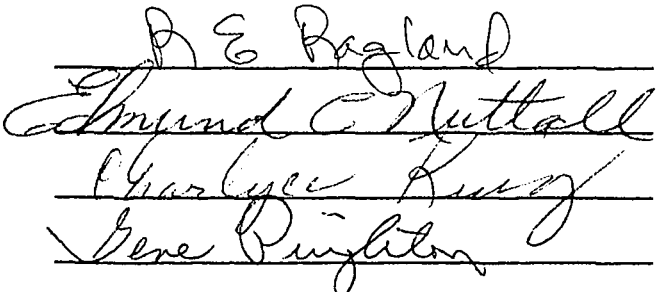
PAULINE JEANETTE LAMBETH

Norman, Oklahoma

1976

THE PERFORMANCE OF CHILDREN OF DIFFERENT RACES, SEX, AND GEOGRAPHIC AREAS ON SELECTED PIAGET CONSERVATION TASKS

APPROVED BY



DISSERTATION COMMITTEE

ACKNOWLEDGEMENTS

Special thanks are extended to the public school systems and individual parents of Sand Springs, Boley and Okemah, Oklahoma for their permission and willing assistance in the obtainment of subjects. Appreciation and gratitude are also extended to:

Dr. Robert Ragland, who not only supplied guidance as committee chairman, but gave inspiration and continued to keep his faith in me;

Dr. Edmund Nuttall, serving as a committee member, gave a great deal of time and help during my research;

Dr. Charlyce King, committee member, for her continuous confidence in me;

Dr. Gene Pingleton, who gave his support during the final stages of this dissertation;

Regina Baxter, who traveled hundreds of miles to administer the tests for this research;

My friends, who listened to my many ideas and kept up my spirits throughout the writing of this dissertation, especially Judy Turner who kept many late hours typing my first draft of this dissertation;

And to my family; my mother, Mrs. Pearline Daniels, who gave me her love and understanding; my sisters and

brothers who gave their help in every way especially my sister Sadie without whose help I could have never continued my education;

To Mr. and Mrs. Lambeth, my father- and mother-in-law, who were always there when I needed them;

And finally to my children, Roland, Jamey, and Rachel who put up with all my moods and many hours away from home in writing this dissertation.

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CHAPTER I

INTRODUCTION

The intellectual or cognitive development of children has been a major concern of educators and educational planners for some time. There is a continuing search to identify the factor or factors, if any, that influence the rate at which a child develops cognitively.

During the past fifteen years new laws concerning equal rights (Civil Rights Act, 1964)[1] and school desegregation by busing (1971-72)[2], created a great need for research in the area of children's intellectual ability. Namely, these laws have changed the educational make-up of schools in that all races of children are combined in the same learning situation. The necessity to close several small rural and suburban schools in some cities adds a second dimension to the already complex situation.

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[1]Civil Rights Act, 1964, Discrimination by race, color, or creed unlawful.

[2]Desegregation of schools by busing, Federal Court Order, 1971-72, Oklahoma City, Oklahoma.

For a successful application of Piaget's ideas to be made on the part of educators, a number of questions must be investigated.

One of the questions in need of further research concerns what effects, if any, environment (geographical area) or race have on children's cognitive development. This study investigated these factors, using conservation tasks as measures of cognitive development. Black, White, and Indian children from urban, suburban, and rural areas served as experimental subjects.

Introduction to Piaget's Theory

Jean Piaget, a Swiss psycholcgist actually trained as a zoologist, gathered much of his data as a parent observing the development of his own children. However, Piaget did not think of himself purely as a child psychologist, but rather as a "Genetic Epistomologist"--one who uses information concerning cognitive development of the child and historical development of culture as a foundation for theories aimed at understanding the nature of both individual and social knowledge (Piaget, 1950).

Jean Piaget has become known as the foremost contributor to the field of cognitive or intellectual development. It was Piaget who explored the profoundly complex problem of conservation, which touches one aspect of the child's ability to construct a reality which transcends the mere appearance of things (Ginsburg and Opper, 1969).

Conservation involves maintaining the original image of an object or objects, after distortion has taken place. A conserving child's cognitive development is at a stage which enables him to see that the quantitative aspects of an object do not change unless something has been added or taken away. A child who is able to conserve makes his judgments based on an object's original state and not on the perception of the object after it has been distorted. Piaget refers to the conserving child as "concrete operational" or in the concrete stage or period of operation.

An operation is a thought that is characterized by rules of logic. Since the child acquires conservations early in this period, and since the concepts of conservation are manifestations of operational thinking, the period is called operational. It is also termed concrete because the child's thinking deals with real objects or those that can be imagined (Piaget, 1954).

Transition to concrete operations is marked by the acquisition of one or more conservations. Piaget's theory divides intellectual development into four major periods or stages: sensorimotor (birth to 2 years), preoperational (2 years to 7 years), concrete operational (7 years to 11 years), and formal operational (may be reached as early as age 11, and in some instances is never accomplished) (Piaget, 1958).

Piaget has gone to great lengths to dispel some

misinterpretations concerning his stage theory. He points out, first, that the ages at which the stages occur vary considerably both within and among cultures. Not all children attain stage two of number development at six years, and some children lag behind by approximately four years. The course of an individual's development moreover is continuous. The child is not one day characterized by stage one and the next day by stage two. The transition is gradual from one stage to another, and occurs over a period of time. The child may also display different levels of achievement in regard to problems involving similar mental operations. This is known as horizontal decalage.

The concrete operational child is attuned to changes. In the conservations, he concentrates on the actual transformation: The act of pouring the liquid, in conservation of liquid amount, or spreading apart a set of objects, in conservation of number, or deforming a ball into a sausage, in conservation of solid amount, are examples. He forms more or less accurate images of the changes which have taken place, and therefore can reason, for example, that as a set of discrete objects expands in length it simultaneously decreases in density. In the conservation of liquid amount, the child realizes that pouring from a tall thin glass "A" into a lower wider glass "B" negates the action of pouring from "B" to "A." In other words, he is aware that it is the same action performed in another direction. By carrying

out the action mentally, that is, by reversing the pouring in his mind, he is able to ascertain that the quantity of water in glass "B" is the same as in glass "A." He can perform a mental operation which enables him to return to his original starting point.

The concrete operational child can also perform another type of reversibility when operating on relations. This is "reciprocity." For instance, in the example of liquid amount, when the child says that one glass is longer and thinner, whereas the other is shorter and wider, he is cancelling out the differences between the two glasses by an action of reciprocity. One difference balances out the other, with the result that they have a reciprocal relationship.

In speaking collectively of two types of children, it can be said that the preoperational child's thought is irreversible, attentive to limited amounts of information, and focused on only one aspect of a given situation, whereas the concrete operational child focuses on several aspects of the situation simultaneously, is sensitive to transformations, and can reverse the direction of his thinking.

Piaget's theory of the acquisition of conservation is significant in the fact that it is an indication of the development of fundamental logical thinking.

Statement of Problem

A review of research in the area of children's ability to conserve reveals that it is incomplete as far as relating conservation to race and geographic area of children. Based on this finding, the focus of this investigation centered on establishing whether a difference exists in children's ability to conserve at certain age levels between race or geographic area within a certain income range, and to ascertain if conservation is more prominent in a certain race or geographic area within a certain income range.

Purpose of Study

The purpose of this study was to investigate the relationship between conservation, ethnic group membership, and geographical area, using Indian, Black, and White children from families with homogeneous incomes in urban, rural, and suburban areas.

Research Hypotheses

The experimental design most effective in examining main effects, area and race, was a 3 X 3 factorial analysis of variance. This analysis of variance using the grand total conservation scores was applied to hypotheses one and two. Hypothesis II will be stated as a null hypothesis; Hypotheses I, III, and IV will be stated in alternative form.

H_1 There will be a statistically significant difference between the grand total conservation scores of children from different geographic areas.

Rural, urban and suburban children will exhibit different degrees of conservation regardless of race.

H_2 There will be no statistically significant difference in the conservation scores of children of different races.

All children will exhibit the same degree conservation regardless of race.

In addition to the above, two ancillary hypotheses were tested by use of a one-way ANOVA.

H_3 There will be a statistically significant difference between the conservation scores of male and those of female children.

H_4 There will be a statistically significant difference in the conservation of children due to age.

Each of the four hypotheses were tested for significance at the .05 level. In addition, a Cochran's C test was used to test for homogeneity of variance at the .05 level of significance in hypotheses III and IV.

Definition of Terms

Piaget was discouraged with the power of existing language to express his ideas, and made use of special definitions of terms specific to his own work (Kennedy 1971).

Adaptation refers to adjustment to the demands of the environment through the process of accommodation and assimilation. (Kennedy, 1971).

Accommodation refers to changes in the schemas as a

result of new experiences--a gradual learning process involving trial and error, exploration, questioning, probing, and experimentation. (Kennedy, 1971).

Concrete operations involves internal manipulations of objects that are (or have been) perceived; thinking that is dependent on the concrete, real world (Gorman, 1972).

Conservation is realization that one aspect of something, e.g., quantity, remains the same while another aspect is changed, e.g., shape, position (Gorman, 1972).

Decentering is taking into account of not just one but two (or more) aspects of something at once (Gorman, 1972).

Equilibration is the active process by which a person responds to disturbances in his ordinary way of thinking through a system of compensations, the result is new understanding and satisfaction, i.e., equilibration (Baldwin, 1967).

Equilibrium refers to equivalence or a state of balance, satisfaction, or understanding (Gorman, 1972).

Horizontal decalage is a display of different levels of achievement in regard to problems involving similar mental operations. (Ginsburg and Opper, 1969).

Inversion is the type of reversibility in which one operation is negated by an opposite operation (Gorman, 1967).

Maturation refers to the organic growth of the bodily systems (Gorman, 1972).

Negation refers to the type of reversibility in which one operation is cancelled out by the opposite operation (Gorman, 1972).

Reciprocity is the type of reversibility in which the effect of a force or action is compensated for by another force or action. (Gorman, 1972).

Reversibility is the transformation by which a person is able to return to the starting point of a problem or situation after an operation had changed it (Lafrancois, 1973).

Schema refers to any related sequence of mental or physical activities (Kennedy, 1971).

Seriation refers to the process of arranging elements according to increasing or decreasing size (Gorman, 1972).

Stages refers to successive developmental periods, each characterized by certain types of activities or operations (Kennedy, 1971).

Structure is an ordered, interrelated system of knowledge or operations (Gorman, 1972).

Transformation is a change from one state (e.g., shape, position, arrangement) to another (Gorman, 1972).

Vertical Decalage occurs where verbal thought lags behind the action itself. "The verticality refers to an ascending age scale: what the child learns at age seven on a plane of action, he must restructure at age eleven on a plane of verbal thought. 'Decalage' refers to the gap or lag.'" (Ginsburg and Opper, 1969).

CHAPTER II

REVIEW OF RELATED LITERATURE

Studies relating to Piaget's theory of cognitive development are numerous. Some are in support of Piaget's theory while others go to great lengths to disprove his theory. Piaget (1971) states transformation (equivalence) and identity are forever inseparable, and it is the possibility of composing them among themselves that constitutes the proper work of reason: Neither identification or even resemblance precedes the organization of change or of difference, and this is what jointly constitutes the operatory instruments capable of coordinating one and another.

Elkind (1967) made an effort to show that every conservation problem assesses two forms of conservation--identity and equivalence--and that Piaget's theory of conservation is a theory of the conservation of identity and not of equivalence. He summarized that the conservation problem can be said to assess two types of conservation: equivalence and identity. However, he goes on to state that the conservation of identity must always be inferred from the child's responses, whereas the conservation of equivalence is reflected directly in the child's judgments. (This would

indicate that the conservation of identity depends on the judgment of the examiner as to true conservation or guess work on the part of the child.)

Following the same line of research, Moynahan and Glick (1972) reviewed the conceptual distinction between identity conservation and equivalence conservation. Ninety six kindergarten and first grade subjects were given both identity and equivalence conservation tasks within four conceptual domains: number, length, continuous quantity, and weight. They state that the results from this study indicate that identity conservation generally does not precede equivalence conservation; instead, the two conservations tend to co-occur. Likewise the hypothesis that the relation between identity and equivalence conservation varies with the conceptual domain receives little support from the present findings. They concluded that for almost all the transformations identity and equivalence conservation co-occurred thus indicating that across a variety of tasks the relation between identity and equivalence conservation is markedly similar.

Using a nonverbal classification test (Goldstein-Scheerer Test) for the study of the development of thinking in children, Reichard, Schneider, and Rapaport (1950) concluded that there are "three levels of conceptual development, namely: concretistic, functional, and conceptual. The first characterizes the youngest children. The second

stage begins when the children make their first relevant classifications, which they do mainly in terms of what use the objects are to them. This functional level of concept reaches its peak in children of 8 to 9, after which it is gradually replaced by more mature, conceptual classifications."

Gerstein (1949) suggested that these three levels of abstraction are applicable to the scoring of the vocabulary of the Wechsler-Bellevue Scale. Gerstein has accepted the assumption that concrete or descriptive definitions of words represent the lowest level of intelligence, and these definitions are replaced first by a functional and then by abstract responses as the child gets older. However, no evidence is presented by Gerstein to support this thesis.

A study by Stacey and Portnoy (1952) compared two groups of mentally defective and borderline children on the vocabulary subtest of the Wechsler Intelligence Scale for Children. Their findings show that both groups used predominately functional responses, but the borderline group gave more concrete (descriptive) and fewer functional responses than did the defective group. Thus, the assumption that concrete responses represent a low level of intelligence is not supported by their results.

A number of research studies designed specifically to teach conservation to young children prior to the time they would be expected to acquire it naturally have been unsuccessful.

Wohlwill and Lowe (1962) devised an investigation in which the nature of the concept of conservation of number could be examined in the context of a learning study. Three training conditions and a control condition were compared. The investigators hypothesized that the training condition in which elements were added to and subtracted from a set of objects would be the most effective. Wohlwill and Lowe reasoned that the addition and subtraction condition would increase the salience of number cues in relation to the usually salient cues of changing length. Contrary to their predictions, the control group with no training in "conservation" performed as well as any of the training groups.

Extensive research into the training of children on conservation of weight and substance was done by Smedslund (1961). A series of six research articles were published by Smedslund dealing with training methods in the two areas. One article reported an attempt to teach forty subjects in the age range of five to seven years to conserve weight. The children were divided into two groups based on the results of a pretest. One group was involved in thirty-two reinforced trials. After each child had made a prediction about two identical pieces of plasticene in which one piece was later deformed, his prediction was tested on balance scales. Another group was subjected to training using balance scales, while the plasticene was changed by adding and subtracting pieces. A third group acted as a control group with no training. Although the conservation of each

group improved on the posttest, there was no significant differences between groups.

Gagne's learning set analysis was used by Kingsley and Hall (1967) as a basis for teaching young children length and weight conservation. Two instructors alternated in conducting individual training for a maximum of nine 20 minute sessions. Analysis of results using both parametric and nonparametric techniques yielded highly significant training effects. In addition, experimental groups improved significantly more than control groups in substance conservation. They concluded that sufficient evidence was presented which indicated that this was due to the similarity of weight and substance tasks.

Wallack, Wall and Anderson (1967) used a procedure involving experience with reversibility to induce six and seven year old children to conserve number. All of the children in the study were said to regard the number of objects as changing when a set of objects were rearranged. One of the questions they sought to answer was whether conservation of the quantity of a liquid could itself be induced by training irreversibility. Results showed that on liquid posttest (following liquid reversibility) only 4 of 16 subjects gave clear conservations answers. These data did not provide much support for the effectiveness of reversibility training for liquid conservation.

Piaget's theory of stages of development prompted a

study conducted by Whiteman (1967). On the basis of the distinction drawn by Piaget between the preoperational intuitive stage (around 4-7 years) and the concrete operational stage (around 7-11 years), Whiteman investigated the child's conceptions of psychological causality. A number of investigations of the child's concept of physical causality have been brought forth, and relatively little dealing with psychological causality. Whiteman's position is that it would seem as appropriate to ask a child, "What makes people angry?" as it is to ask him "What makes clouds move?"

The study involved interviewing 57 five and six year old children and 55 eight and nine year olds with respect to their understanding of the motivations of a child in seven story situations.

In a study conducted by Bucky and Banta (1972), thirty-six Black and thirty-six White preschool children were individually interviewed by Black and White experimenters for ten minutes and were then given tests of motor impulse control, reflectivity, innovative behavior, and curiosity. The following combinations were tested:

White E - White S

Black E - White S

Black E - Black S

White E - Black S

Results indicated that for every test and on every social interaction variable, White subjects tested by White

experimenters did better than when tested by Black experimenters. The impact of the White experimenter was less pronounced for Black subjects. However, Black subjects also achieved higher scores with White experimenters than with Black experimenters. Other results indicated that Black children tested by Black experimenters generally scored lowest.

Studies done on Piaget's theory of cognitive development are numerous. Scott and Sattel (1968) investigated whether the development of culturally handicapped children's cognitive capabilities are more dependent on verbal or nonverbal experiences.

Scott obtained correlations of a perceptual test (Operational Readiness Step-Variation Seriation Test: ORS ST) with a language oriented test (Metropolitan Reading Readiness Test: MRRT) with Black and White, lower and middle-class, kindergarten children (CA 5-8 to 6-7) who resided in the American Midwest. The resulting intertest correlations (average = .82) supported the Piaget and Inhelder view that at least during the early years, perceptual and language skills are highly interactive and that significant correlations were obtained between perception and language skills, irrespective of sex or degree of disadvantage. Contrary to expectations, the findings revealed wide interrace but insignificant social class and intrarace differences. Scott interpreted from these latter findings that generally lower

scores of the Black American may reflect experiential impoverishment in both the perceptual and language spheres and that this interaction effect may act to deter general cognitive growth of both Black and White disadvantaged children. When the subjects were in the third grade a follow-up study revealed that both perceptual and language skills were significantly correlated with subjects' attainment in all major subject areas. With Black subjects, predictive correlations were lower, adding weight to the argument that cultural factors might impede general cognitive growth. In a recent report, Scott also reports that disadvantaged children were less consistent in performing seriation tasks; perceptual scores of deprived children appeared often to estimate not actual abilities but the impingement, or cognition, of motivational and affective factors which adversely influenced development of what Cattell (1966) has referred to as "crystallized intelligence." The pattern of these findings indicate that interaction of language and perception, rather than attainment in one of these areas, is vital to learning.

Odom (1967) designed a study to investigate the effects of social class on the development of problem-solving strategies in 120 Black 5, 6, and 10-year-old children from two socioeconomic backgrounds. A three choice discrimination task was employed in which one choice was rewarded according to a partial schedule while the other choices were never rewarded. The results indicated by Odom were that age and

socioeconomic background of subjects played significant roles in determining the kind of problem-solving strategy employed. As age and socioeconomic level increased, strategies thought to reflect higher cognitive processes also increased.

The performances of Black 6 and 9-year-old children from Prince Edward County, Virginia were examined by Mermelstein and Shulman (1967). This community was selected due to the absence of public school for four years. The children were tested on a series of Piagetian conservation tasks, and compared with other Black children from a community which had had regular schooling. Mermelstein and Shulman's findings revealed no significant differences attributable to effects of nonschooling.

A study concerning the ability of preschool children to use relational terms "more," "same," and "less" when comparing the number, length and weight of objects was conducted by Griffiths, Shantz and Sigel (1967).

The subjects were fifty-four children, 33 girls and 21 boys, who attended local nursery schools. The ages ranged from 49 to 62 months with a mean age of 55 months. Children were reported to have had the most difficulty using the term "same" correctly. The relevance of these findings to the author's study will be discussed. These children had least difficulty correctly using all terms in length comparisons. For weight and number, the correct use of the terms

was most often an elicited response.

One of the most recent studies relating to the author's research was conducted by Stafford[1] in 1969, entitled "The Influence of the First Grade Program of Science Curriculum Improvement Study on the Rate of Attainment of Conservation." Using experimental and control samples each consisting of sixty first grade children, Piaget's conservation tasks of number, liquid amount, solid amount, weight, length and area were administered to each child.

The study concluded that there was no significant difference in the rate of attainment of conservation when the groups were divided by sex, that ability to conserve was related to I.Q., and that the rate of attainment of the conservation skills was significantly enhanced by the experiences made possible by the first grade program of the Science Curriculum Improvement Study.

The data also suggested no statistically significant differences in the rate of achievement by sex on any basis of comparison used.

One of the most pertinent studies by Gaudia (1972) investigated the rates of acquisition of conservation between children of different racial and social class backgrounds.

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[1]The Influence of the First Grade Program of the Science Curriculum Improvement Study on the Rate of Attainment of Conservation, a dissertation submitted by Donald Gene Stafford in partial fulfillment for the degree of Doctor of Philosophy, 1969, University of Oklahoma, Norman, Oklahoma.

Three groups of 42 children each, American Indians, Black, and Whites made up a sample of 126 subjects. Each group contained seven boys and seven girls from each of the first three grades. One conclusion made in this study was that there are major differences in rates of acquisition of conservation between children of different racial and social backgrounds. Within the lower-class research sample, Black children were behind Indian and White children in rate of acquisition and, specifically, older Black children seemed to be further behind. The increasing difference between racial groups with increasing chronological age suggests that lower-class environments may be entirely different among different races.

Piaget (1971) made reference to a study conducted in Iran by Mohseni in 1966. Children schooled in the City of Tehran and Young Country illiterates were questioned by means of conservation tests. The three principal results obtained from children age five to ten were: (a) In general the same stages in city and country, in Iran and Geneva, were found. (b) There was a systematic difference of two to three years for operatory tests between Villagers and City dwellers but about the same ages in Tehran and in Europe. (c) Retardation was considerable at the age of four and especially five for performance tests between Villagers and City dwellers to the point where the former appeared mentally defective without operatory tests (conservations).

An investigation of Piaget's theory was conducted by Renner et al. (1973) to employ Piaget's theory in elementary schools in a practical manner. Six of Piaget's conservation tasks (number, solid amount, liquid amount, length, area, and weight) were administered to 252 children in the Norman, Oklahoma Public Schools. The results indicated that all children do not become concrete thinkers on all tasks at the same time. All of the children in the sample conserved number by the age of seven years, liquid amount by age seven years, four months, length by ten years eight months and area by eleven years of age. Younger children conserved on tasks 1-3, while older children conserved on tasks 4-6.

In summary, although conservation has been one of the most widely investigated concepts related to Piaget's theory of intellectual development, research cited is concentrated in the area of age of attainment of conservation, in relation to IQ, socioeconomic level (especially low socioeconomic level), and race. Piaget emphasizes that the understanding of concrete operations is oriented toward the actual observations of concrete events in the child's environment (Baldwin, 1967). By extending the area of research to include race and geographic environment in relation to children's ability to conserve, this study can lend some much needed clarification as to the relative influence of these two factors on the development of intellectual ability in children.

CHAPTER III

METHODS AND PROCEDURES

The Boley, Oklahoma school system was selected to obtain Black Rural subjects. White and Indian Rural subjects were obtained from the Okemah, Oklahoma school system. Suburban subjects, Black, White and Indian were selected from the Sand Springs, Oklahoma school system. Black, White and Indian students living in the Oklahoma City, Oklahoma area made up the urban population.*

After geographic areas were identified, homogeneity of income was achieved by randomly selecting those children whose parents' or guardians' annual incomes fell in a range of $8,000 to $12,000 a year. Income was estimated by occupation, using information obtained from The Occupational Outlook Handbook (1973-74).

Subjects

Subjects were selected from separate enrollment records of male and female students by dates of births. Every second name on each list of male and female students in each race was selected between the ages of 5 years,

*In all, there were 90 subjects, ten in each of the 9 categories, with each set divided into 5 males and 5 females.

6 months and 7 years, 3 months, with an equal number of boys as girls. These students had been previously screened by individual teachers and principals so that all were in the normal range of intelligence, and had lived in the area for at least two years.

Test Instrument

Studies cited, such as Renner, et al. (1973) clearly indicate that children in the younger age range (5.6-6.6) conserve more readily on conservation of number, solid amount, and liquid amount (tasks 1-3), and do not conserve on conservations of weight, length and area (tasks 4-6). A high performance by older children (6.7-7.4) on tasks 4-6, conservation of weight, length, and area is also indicated. Due to results of research conducted on conservation tasks as in the above study, those tasks mentioned and the arrangement of those tasks were used in the present study and were sequenced according to probable degree of difficulty due to the age of attainment of certain tasks.

The test instrument consisted of six Piagetian conservation tasks: Task 1, conservation of number, involved linking up six black checkers and six red checkers in a parallel row. Once the child confirmed there was as many red as black checkers, the red checkers were stacked into one stack. The child was then asked if there were still as many red checkers as black checkers. Task 2, conservation of solid amount involved presenting the child two pieces of

clay rolled into balls of equal size, one blue and one red. Once the child confirmed that there was the same amount of blue clay as red clay, the blue clay was deformed by rolling it into the shape of a "snake." Task 3, conservation of liquid amount, involved pouring equal amounts of water into two containers that were equal in size. After the child confirmed that both the size of the containers and the liquid in them were equal, the water from one container was poured into a taller, thinner container. Again the child was asked about the equality of the water. Task 4, conservation of weight, involved giving the child two balls of clay of equal size and allowing him to add and subtract clay until he agreed the balls were the same size. One of the balls was then deformed to resemble a pancake. Without touching the clay, the child was asked if the pancake would weigh the same as the ball of clay. Task 5, conservation of length, dealt with placing two rods or sticks side by side so that their ends corresponded. When the child had confirmed that each was the same length, one of the sticks was moved so that their ends no longer corresponded. The child was again asked if the sticks were equal in length. If an affirmative answer was given, two toy horses of equal size and color were placed at the end of each stick. The examiner stated that they would pretend the sticks were roads, and asked if each horse would reach the end of their roads at the same time. Task 6, conservation of area, involved presenting the child

with two pieces of green construction paper of equal shape and surface area that represented "fields of grass." A number of small wooden blocks of equal size, shape, and color were placed before the child that represented "barns." One "barn" was placed on each "field of grass." A second and third "barn" was placed on each "field of grass." On field A, the barns were placed side by side. On field B, the barns were scattered. To test the possibility that children might be conserving number (when he counts the barns and gives an explanation that they are the same because both "fields" have the same number of "barns") and not area, another "barn" is placed on the field A and in field B the barn is placed on top of an existing barn.

Method of Recording

Subjects were identified by number from 1-10 for each race and area. Space on the data sheet was also provided for birthdate, sex, and a conservation and non-conservation score of each child.

Pre-examination of Population

Each population was screened as to IQ and previous knowledge of Piaget's conservation tasks. This information was obtained from the principal and teachers of selected elementary schools. Only those children whose IQ scores fell within the normal range of intelligence were included in the study as subjects.

Selection of Examiner

The examiner, a white female, age 23, was selected from a group of recent special education graduates of the University of Oklahoma, and trained to administer each of the six Piagetian conservation tasks. In the light of Bucky and Banta's (1952) findings, described on pages 16 and 17 preceded, it was concluded that a white examiner would be effective with all ethnic groups. The examiner was instructed to state to each child:

> I will ask you to do some things for me and answer some questions about them. Some of them may be easy and some may be a little harder. Do the best you can on each of them.

The following four steps were used in the presentations of each task: First, the child was given an opportunity to familiarize himself with the materials; second, it was ascertained whether each child perceived the initial equality of objects he was asked to compare; third, after each manipulation of one of the two objects, the child was again asked to judge the object's equality or inequality; and fourth, the subject was asked to explain why the two objects were equal or unequal (depending on his response) with respect to a given area of conservation. Explanations were scored as conserving or non-conserving (see Appendix B).

Procedure

In each elementary school site, a quiet room away from the normal traffic of children was provided by each

principal. The examiner administered six of Piaget's conservation tasks (as described previously) to each of 90 subjects individually. Administration time for each subject was 10-15 minutes. All 90 subjects were tested in the spring semester of the 1975-76 school year, over a period of three and one-half weeks. Subjects were given a score of "1" point for each task on which they successfully conserved with each subject receiving a total possible score of 6 points. A score of "0" was given for nonconservation. The same examiner administered 6 Piagetian tasks to all 90 subjects. During the testing, the examiner encountered difficulty in making her language understood with the subjects making up the Black Rural population. Further discussion follows in Chapter V.

Treatment of Independent Variables

Area was divided into Urban, Rural, and Suburban; race was divided into Indian, Black and White; age was divided into group 1, 5.6-6.1, group 2, 6.2-6.8, group 3, 6.9-7.3; and sex, group 1, male, group 2, female.

Statistical Design

A 3 x 3 factorial analysis of variance was used to analyze the data in this study. Geographic area and race are the two factors that were examined, with each factor consisting of three levels. The degrees of freedom were: factor 1, geographical location = 2; factor 2, race = 2;

interaction = 4; total = 89; and for within (error) = 81. This consisted of nine cells, with ten subjects in each cell. Only the grand total conservation scores were used in calculation of the factors mentioned above. A one-way ANOVA was then used to calculate the grand total conservation score by sex and age in the two ancillary hypotheses.

	Urban	Suburban	Rural
Indian	N=10	N=10	N=10
Black	N=10	N=10	N=10
White	N=10	N=10	N=10

The level of significance was reported in each case to supply as much information as possible to any future research on Piaget's theory.

CHAPTER IV

RESULTS AND DATA ANALYSIS

Statistical Procedure

The findings for the present dissertation will be presented in the following order:

1. Results relating to the testing of Hypothesis I, concerning the conservation scores of children from different geographic areas and results relating to the testing of Hypothesis II. Concerning conservation scores of children from different races.

2. Results relating to the two ancillary Hypotheses, that is Hypothesis III, concerning the differences in the conservation of male and female children, and Hypothesis IV, relating to age of conservation.

The means and standard deviations of main effects (area, race) are presented in Appendix D. Hypotheses I, III, and IV will be stated in alternative form. Hypothesis II will be stated in a null form.

Results

Hypothesis I

Hypothesis I stated that there would be a statistically significant difference between the grand total conservation scores of children from different geographic areas, regardless of race. Results of a two-way analysis of variance for the main effects were $F = 0.98$, $df = 2,81$, $p < 0.99$, for area. Hypothesis I is not supported by statistical results and is rejected.

Hypothesis II

Hypothesis II predicted that there would be no statistically significant difference in the conservation scores of children of different races. A two-way ANOVA was also used to calculate for the main effect of race on the grand total conservation score. A relationship between race and ability to conserve was not demonstrated in the overall sample ($F = 0.75$, $df = 2,81$, $p < 0.99$). Hypothesis II can therefore be accepted.

Although no significant difference was found in area and race as having any direct influence on conservation, an interaction is clearly indicated between the two main effects of area and race ($F = 2.65$, $df = 4,81$, $p < .05$) (see Table 2). A trend toward the suburban area is apparent from the data graphed in Figure 1. In addition, another trend toward the Indian race is also demonstrated in Figure 2. However, it should be noted that these are trends and neither indicate any statistically significant difference.

TABLE 2

TWO-WAY ANOVA
GRAND TOTAL CONSERVATION SCORE

Source	df	MS	F	P<
Area (A)	2	2.13	.98	0.99
Race (R)	2	1.63	.75	0.99
Interaction A x R	4	5.76	2.65	.03
Within (Error)	81	2.17		
Total	89			

Ancillary Hypotheses

Hypothesis III

Hypothesis III stated that there would be a significant difference between the conservation scores of male and female children. A one-way ANOVA was applied to Hypothesis III ($F = 0.47$, $df = 1,88$, $p < 0.49$). No significant difference is indicated in conservation based on the sex of the children. Hypothesis III was rejected.

TABLE 3

ONE-WAY ANALYSIS OF VARIANCE BY SEX

Source	df	MS	F	P<
Between Subjects	1	1.1	0.47	0.49
Within (Error)	88	2.3		
Total	89			

The Cochran's C test for homogeneous variances was calculated ($F_{max} = 0.55$, $P = <0.25$ ns) for degree of homogeneity.

Hypothesis IV

Hypothesis IV stated that there would be a statistically significant difference in the conservation of children due to age. A one-way ANOVA was utilized and yielded the following statistical findings ($F = 3.5$, $df = 2,87$, $p < .03$). Hypothesis IV is confirmed.

TABLE 4

ONE-WAY ANOVA BY AGE

Source	df	MS	F	P<
Between Subjects	2	7.8	3.59	.03
Within (Error)	87	2.1		
Total	89			

When a Cochrans' C test for homogeneity of variances (F_{max} = 3.6, $p < .03$) a high level of significance was obtained.

In addition to providing a means of testing the above hypotheses, the data raise questions which allowed the author to go beyond the hypotheses stated (further details and findings appear in Chapter V).

Factors Affecting Statistical Results

It should be kept in mind that a conclusion based on the present statistical findings would be misleading due to many Indian subjects falling into the upper half of the age range (5.6-7.3). However, for those Black and White subjects falling into this area of the age range, the ability to conserve and the sophistication of explanations was not present.

The fact that age was not evenly distributed throughout the geographic area could account for the data indicating a high relationship between conservation and the Urban Indian population. In the same light, the uneven distribution of

age could have affected other variables, such as sex.

The language difficulty encountered by the examiner during testing in the Black Rural area is another possibility that could have affected statistical results (further details appear in Chapter V).

CHAPTER V

DISCUSSION, CONCLUSIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

Using a two-way analysis of variance to test the two main effects of geographic area and race yielded a non-significant F ratio in each case ($F = .98$, $df = 2,81$, $p < .99$).

However, the two way interaction was highly significant with an F ratio of 2.65 ($df = 4,81$, $p < .03$) between area and race. This interaction is graphed in Figure 3, which shows that urban Indians score higher than their suburban and rural counterparts. Suburban whites fare better than urban and rural whites, while Blacks show very little difference in conservation scores as a function of geographic area. Certain trends were obtained from the data using a one-way ANOVA, particularly concerning task 4, in weight conservation and task 6, in area conservation. Significance was consistent on task 4 with age as a variable ($F = 3.3$, $df = 2,87$, $p < .03$), and on task 4 with area as a variable ($F = 4.1$, $df = 2,87$, $p < .01$). Task 6 revealed significance on a two-way ANOVA with race and area as main effects ($F = 3.3$, $df = 2,87$, $p < .04$), with race showing the significance.

Chi-square statistics were used to examine questions of the data dealing with age groups 6.2, 6.8 and 6.9 to 7.3 in conjunction with area across race on tasks 4 conservation of weight, 5 conservation of length, and 6, conservation of area.,

The Yates' corrected chi-square is reported in each case as χ^2. The Yates correction is necessary due to cell sizes of below 5, to prevent the chi-square test from being distorted or inflated.

The first question examined concerned any statistically significant differences in the number of conserving children on tasks 4 and 6, in age group 2 (6.2-6.8) in each geographic area across race. The following results were obtained on task 4: $\chi^2 = 0.87$, df = 2, $p < 0.64$ for the urban area, $\chi^2 = 0.83$, df = 2, $p < 0.65$ for the suburban area and a $\chi^2 = 3.94$, df = 2, $p < 0.13$ was obtained for the rural area. Task 5 revealed a χ^2 of 4.28, df = 2, $p < 0.11$ for urban area, a $\chi^2 = 0.49$, df = 2, $p < 0.49$ for suburban area, and a $\chi^2 = 3.9$, df = 2, $p < 0.13$ for the rural area. Results on task 6 were a $\chi^2 = 4.28$, df = 2, $p < 0.11$ for the urban area, a $\chi^2 = 3.36$, df = 2, $p < 0.18$ for the suburban area and a $\chi^2 = 4.9$, df = 2, $p < 0.08$ for the rural area.

The second question analyzed was differences involving age group 3 (6.9-7.3) in the different geographic areas of rural, urban, and suburban across race on tasks 4-6. Task 4, conservation of weight, yielded a χ^2 of 6.99 with 2 degrees

of freedom and significance at the .03 level in the urban area. The suburban area showed a χ^2 of 2.80 with 2 degrees of freedom and significance at the 0.2 level. Results were $\chi^2 = 1.14$, df = 2, $p < 0.56$ in the rural area. On task 5, the urban area showed $\chi^2 = 3.23$, df = 2, $p < 0.19$. A χ^2 of 0.45, df = 2, $p < 0.79$ was obtained for the suburban area. The rural area showed $\chi^2 = 2.91$, df = 2, $p < 0.23$. On task 6, results were $\chi^2 = 3.23$, df = 2, $p < 0.19$ for the urban area, and a χ^2 of 0.98 with 2 degrees of freedom in the suburban area was significant at the 0.61 level. In the rural area results were $\chi^2 = 4.03$, df = 2, $p < 0.13$.

Statistical differences indicate an influence of the urban area on tasks 4, in the 6.9-7.3 age group. No statistical difference is indicated toward any particular race.

The examiner encountered difficulty in making her language understood during the six tasks with the sample of subjects from the Black Rural population, particularly with the concept of "sameness." This factor could have had a negative effect if the examiner assumed understanding on the part of the child when the child indeed did not understand or a possible positive effect if the examiner reached a point of coaching in an attempt to make herself understood.

Further research is needed dealing with the relationship of conservation to area, race, and sex, involving older children. Also a closer look is indicated into any effect older siblings in the family might have on conservation

scores of children.

In addition, for those areas or races with the least efficiency in conservation, a further examination of that particular adult population, as to its stage of operation would be another area of research; namely, would this population also be operating on a concrete level, and not have advanced to a formal level of thought?

Because many of the children included in the present study were in a considerably young age range, they were unable to conserve on the more difficult conservation tasks of solid amount, length, and area, tasks numbered 4, 5, and 6. Research aimed at older children, who are more likely to be functioning on the concrete operational level, would yield more conclusive results as to any possible influence race or geographic area might have on children's cognitive development.

In conclusion, the main effects of area and race did not reveal any significance, unless one is considered in relationship with the other. This relationship centered around the Indian race and the urban area. A further look into each area as to the types of concrete experiences that are encountered in each area would lend more conclusive information.

REFERENCES

Baldwin, A. L., Theories of Child Development, John Wiley and Sons, Inc., New York, 1967, pp. 190, 295-296.

Bucky, S. F., and Banta, T. J., Racial Factors in Test Performance, Journal of Experimental Psychology, 1972, Vol. 6, pp. 7-13.

Cattell, R. B., Theory of Fluid and Crystallized Intelligence: A Critical Experiment, Journal of Educational Psychology, 1966, Vol. 54, pp. 1-22.

Elkind, D., Piaget's Conservation Problems, Journal of Child Development, 1967, Vol. 38, pp. 15-27.

Furth, H. G., and Wachs, H., Thinking Goes to School, Piaget's Theory in Practice, New York: Oxford University Press, London-Toronto, 1975, p. 12.

Gaudia, G., Race, Social Class, and Age of Achievement of Conservation on Piaget's Tasks, Journal of Developmental Psychology, Vol. 6, No. 1, 1972, pp. 158-165.

Gernstein, R. A., A Suggested Method of Analyzing and Extending the Use of the Bellevue-Wechsler Vocabulary Responses, Journal of Consultant Psychology, 1949, Vol. 13, pp. 336-374.

Ginsburg, H., and Opper, S., Piaget's Theory of Intellectual Development, An Introduction, Prentice-Hall, Inc., 1969, p. 210.

Goldschmid, M. L., The Relationship of Conservation to Emotional and Environmental Aspects of Development, Journal of Child Development, 1968, Vol. 39, pp. 579-589.

Gorman, R. M., Discovering Piaget, A Guide for Teachers, C. E. Merrill Publishing Co., 1972, pp. 111-115, 444.

Griffiths, J. A., Shantz, C. A., and Sigel, I. E., A Methodological Problem in Conservation Studies: The Use of Relational Terms, Journal of Child Development, 1967, Vol. 38, pp. 841-848.

Kennedy, W. A., Child Psychology, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1971, pp. 444, 445, 447-452.

Kingsley, R. C., and Hall, V. C., Training Conservation through the Use of Learning Sets, Journal of Child Development, Vol. 38, 1967, pp. 1111-1126.

La Francois, Guy R., Of Children, An Introduction to Child Development, University of Alberta, Wadsworth Publishing Company, Inc., 1973, pp. 306, 310.

Mermelstein, E., and Shulman, L. S., Lack of Formal Schooling and the Acquisition of Conservation, Journal of Child Development, Vol. 38, 1967, pp. 39-52.

Moynahan, E., and Glick, J., Relation between Identity Conservation within Four Conceptual Domains, Journal of Experimental Psychology, 1972, Vol. 6, pp. 247-251.

_____, Occupational Outlook Handbook, U.S. Department of Labor, Bureau of Labor Statistics Bulletin, 1974-75 Edition.

Odom, R. D., Problem-Solving Strategies as a Function of Age and Socioeconomic Level, Journal of Child Development, Vol. 38, 1967, pp. 747-752.

Piaget, J., Construction of Reality in the Child, Basic Books, New York, 1954.

Piaget, J., Genetic Epistemology, Vol. I., Mathematical Thought, Vol. II, Physical Thought, Vol. III, Biological Thought, Psychological Thought, and Sociological Thought, University of France Press, Paris, 1950.

Piaget, J., Psychology and Epistemology, Towards a Theory of Knowledge, Translated by Arnold Rosin, The Viking Press, New York, 1971, p. 37, 53-57.

Piaget, J., and Inhelder, B., The Growth of Logical Thinking from Childhoold to Adolescence, Trans. A. Parsons and S. Seagrin, Basic Books, Inc., Publ., New York, 1958.

Reichard, S., Schneider, M., and Rapaport, D., The Development Concept Formation in Children, Journal of Clinical Psychology, 1950, Vol. 14, pp. 156-161.

Renner, J. W., Brock, J., Heath, S. Laughlin, M., and Stevens, J., Teaching Science in the Elementary School, Harper and Row, Publishers, New York, 1973, pp. 394-401.

Scott, R., Perception and Language, Journal of Genetic Psychology, Vol. 120, 1972, pp. 203-210.

Smedslund, J., External Reinforcement of Conservation of Weight, Scandinavian Journal of Psychology, Report 2 (1961), pp. 11-20.

Stacey, C. L., and Portnoy, B. T., A Study of Differential Responses, Journal of Clinical Psychology, 1952, Vol. 6, pp. 401-403.

Wallack, L., Wall, A. J., and Anderson, L., Number Conservation: The Roles of Reversibility, Addition-Subtraction, and Misleading Perceptual Cues, Journal of Child Development, Vol. 38, 1967, pp. 425-442.

Whiteman, M., Children's Conception of Psychological Causality, Journal of Child Development, Vol. 38, 1967, pp. 143-155.

Wohlwill, J., Lowe, R. E., Experimental Analysis of the Conservation of Number, Journal of Child Development, 1962, Vol. 33, pp. 153-167.

APPENDIX A

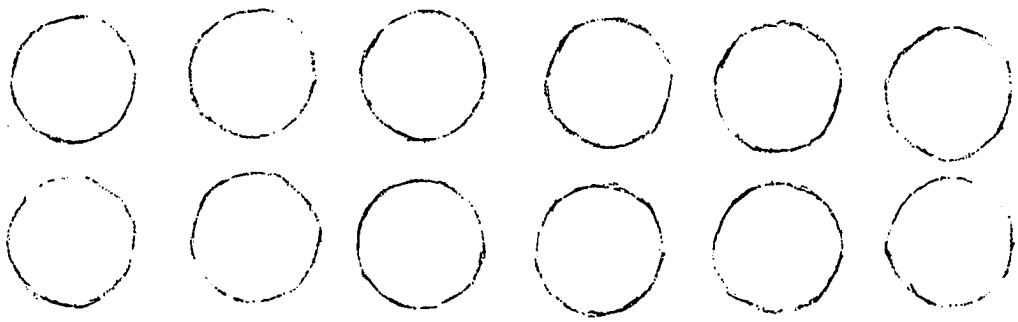
DESCRIPTIONS OF CONSERVATION TASKS

PIAGETIAN CONSERVATION TASKS

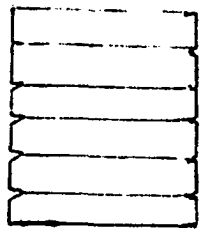
Task 1: Conservation of Number:

Six black checkers were lined up in one row and six red checkers were lined up in a parallel row (see step 1). Shaded color denotes black checkers, vertical lines denote red. Once the child confirmed there was as many red as black checkers, the red checkers were stacked into one stack (see step 2). The child was then asked whether there was as many red checkers as black checkers. If the child confirmed there was still the same amount of red checkers as black checkers, he/she was then asked how he/she knew that. An explanation such as "nothing was added or taken away" was noted as conservation in each of the six tasks, and a negative response was followed by the question "why not?"

Step 1



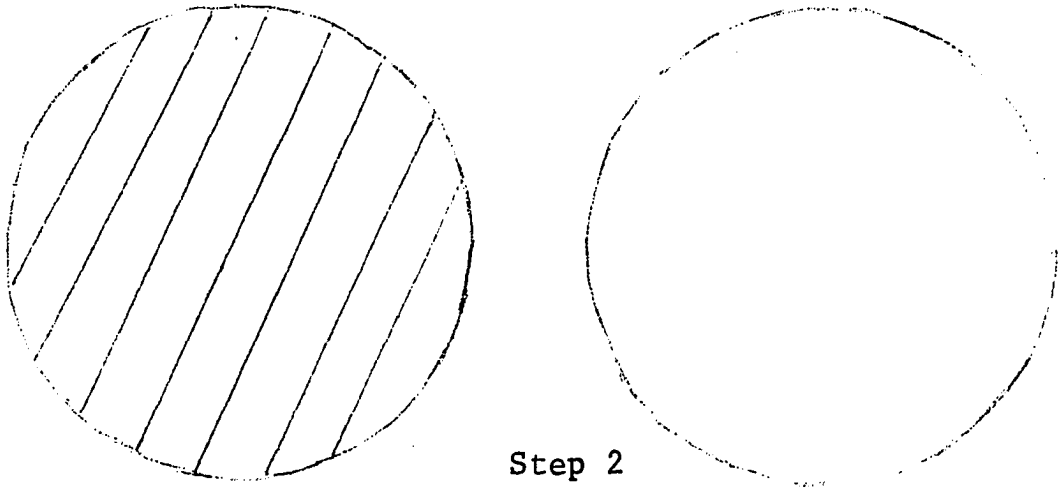
Step 2



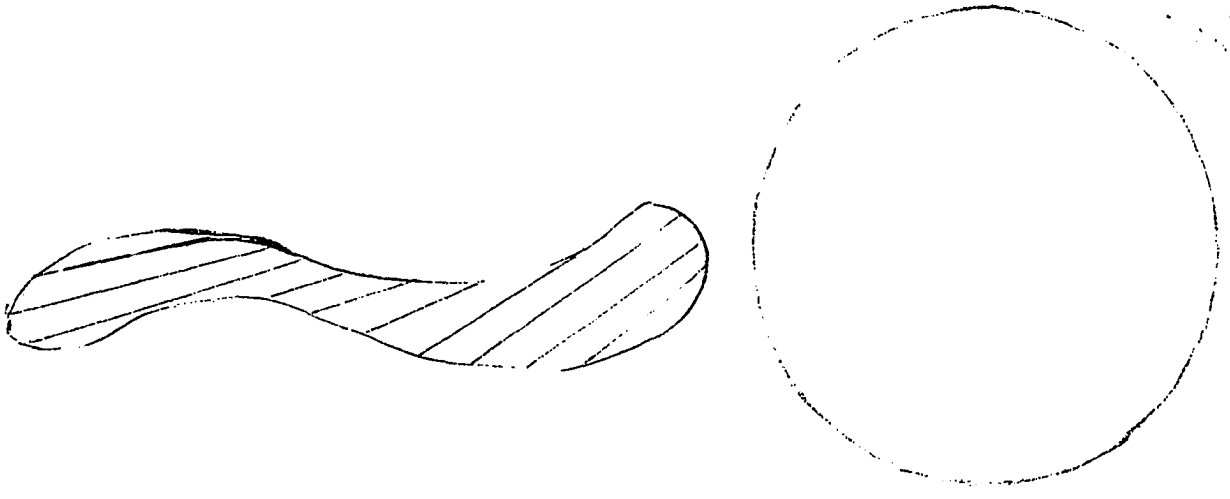
Task 2: Conservation of Solid Amount:

Two pieces of clay of the same amount were rolled into balls of equal size. For convenience two colors were used, blue and red with diagonal lines denoting the blue clay (see step 1). Once the child confirmed that there was the same amount of blue clay as red clay, the blue clay was deformed by rolling it into a "snake" (see step 2). The child was then asked whether there was as much blue clay as red clay. If the child confirmed that both balls were still the same, he/she was then asked how he knew that.

Step 1



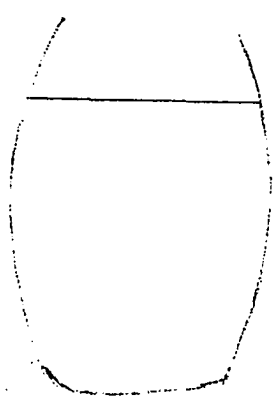
Step 2



Task 3: Conservation of Liquid Amount:

An equal amount of water was poured into two containers of equal size and shape (see step 1). After the child confirmed that the containers were the same size and that they contained the same amount of water (an eye dropper was provided for the child to add and subtract water as needed) the water in one of the containers was poured into a taller, thinner container (see step 2). The child was then asked whether there was as much water in the taller container as in one of the original containers. If the child confirmed that the amount of water remained the same, he/she was then asked how he/she knew that.

Step 1



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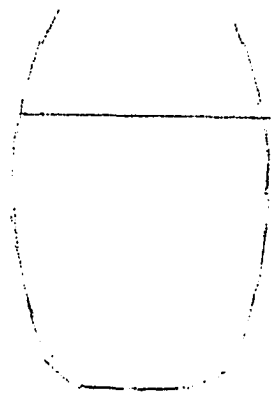
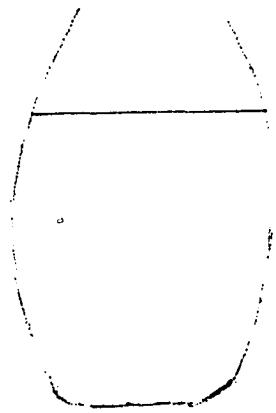
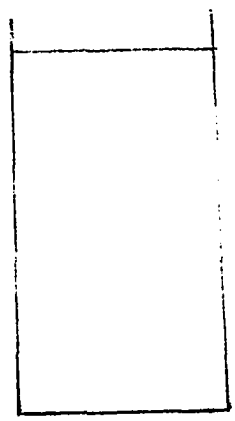


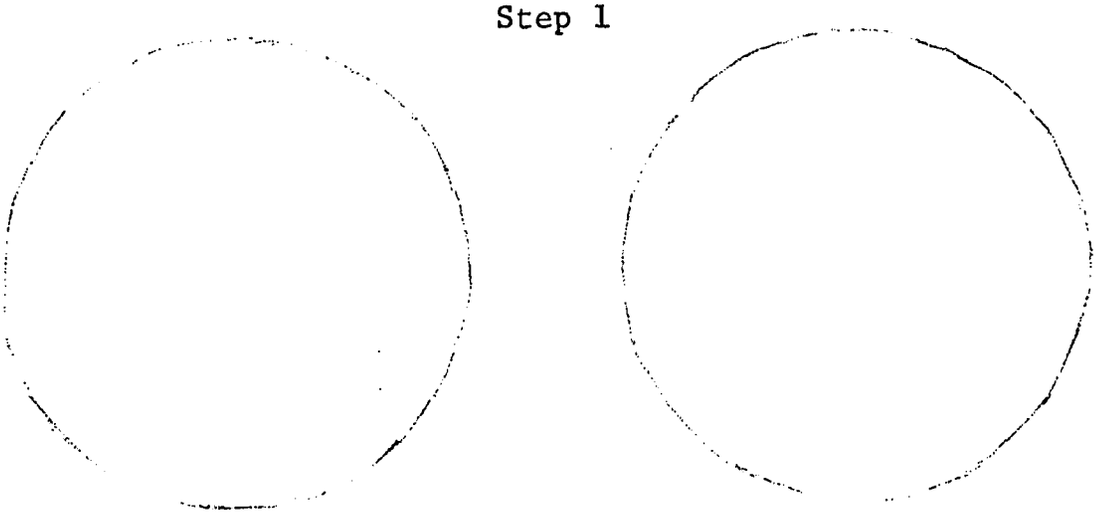




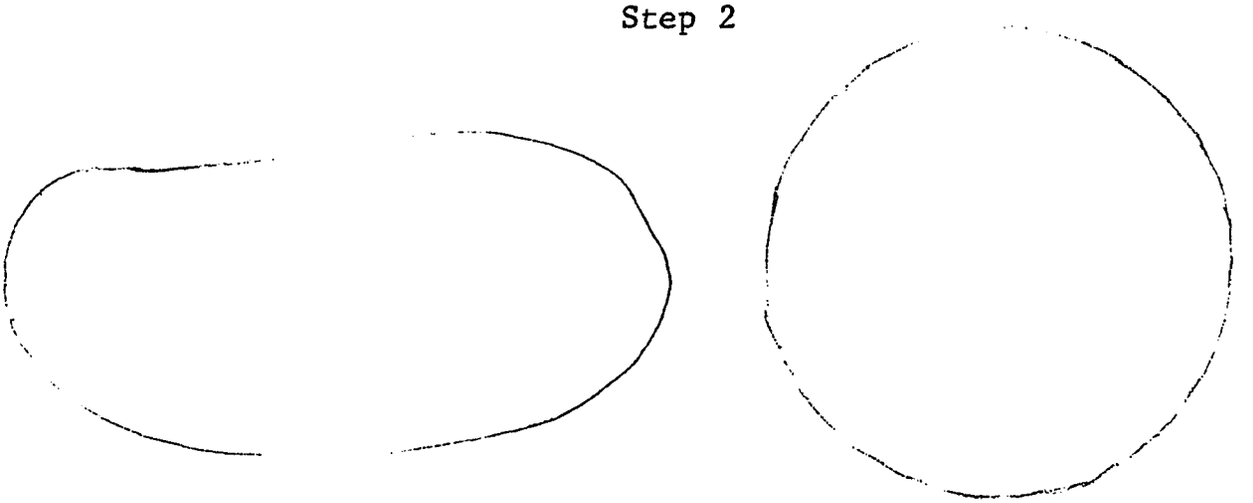
Task 4: Conservation of Weight:

Two balls of clay of equal size and weight were given to the child (see step 1). He/she was allowed to add and subtract clay until he/she agreed that they weighed the same. Then one of the balls was deformed into a pnacake (see step 2). Without touching the clay the child was asked if the pancake would weigh the same as the ball of clay. If the child confirmed that both balls would still weigh the same, he/she was then asked how he/she knew that.

Step 1



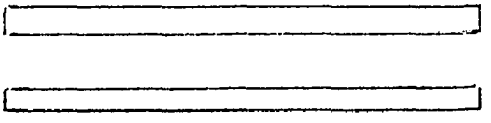
Step 2



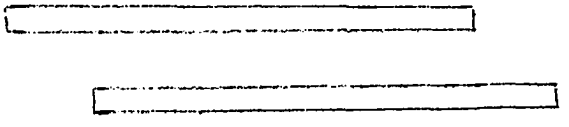
Task 5: Conservation of Length:

Two rods or sticks of identical length were laid side by side so that their ends corresponded (see step 1). When the child had confirmed that each was the same length, one of the sticks was moved so that their ends no longer corresponded (see step 2). The child was again asked if the two sticks were the same length. If he/she confirmed length was still equal, two toy horses of equal size and color were then placed at one end of each stick (see step 3). The examiner stated "let's pretend the sticks are roads," and asked if both horses would reach the end of their road at the same time. If an affirmative answer was given, the child was asked how he/she knew that. An explanation such as "because the roads are still the same distance" was noted as conserving length.

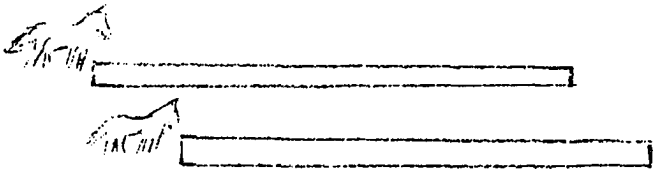
Step 1



Step 2



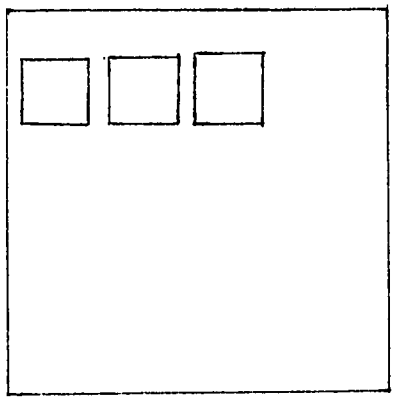
Step 3

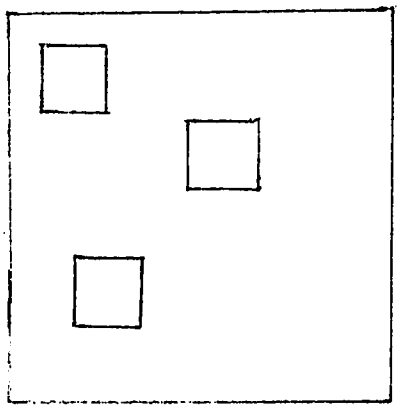


Task 6: Conservation of Area

Two pieces of green construction paper of the same shape and surface area were presented to the child (labeled A & B). Also, a number of small wooden blocks of equal size, shape, and color were presented to the child. When the child confirmed the equality of the papers and blocks, the tester stated "let's pretend each piece of paper is a 'field of grass' and each block is a 'barn.'" The tester then presented two small identical plastic cows and placed one on each piece of paper (see step 1). The child was asked if one cow had as much grass to eat as the other. An equal number of "barns" were placed on each "field of grass." On "field A" they were placed side by side, on "field B," the "barns" were scattered around the paper (see step 2). The child was asked if both cows still had the same amount of grass to eat. If an affirmative answer was given, the task was continued. If a negative answer was given, the task was discontinued. If the child counted the "barns" when asked about the equality of the areas, he was probably conserving number and not area. To test him on this, another "barn" was placed on "field A" and on "field B" another "barn" was placed on top of an existing "barn." If the child stated the cow on "field B" now had more grass to eat, he/she was noted as conserving area.

Step 1





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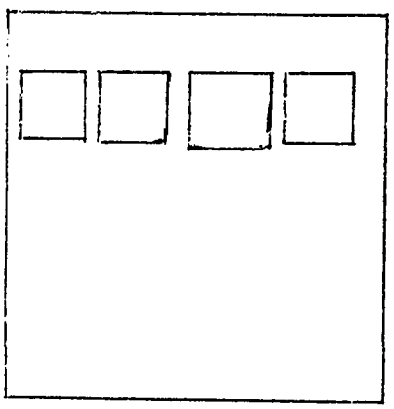

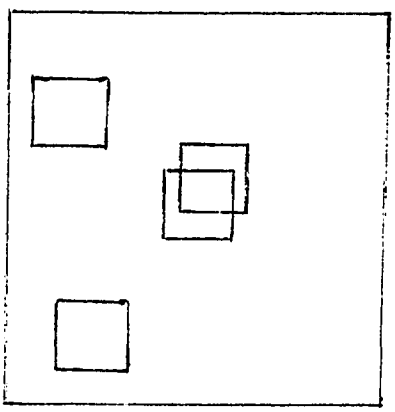

APPENDIX B

CONSERVATION SCORE FORMS

Each population was identified on a separate form indicating race and area (White rural, Indian urban, Black suburban, etc.).

Subjects were listed one through ten under each task by birth dates. Sex of each subject was identified as M, male and f, female. A check mark was made under the appropriate column of conserves and does not conserve. "1" point was given for each successful conservation on each task. A score of "0" was given for nonconservation.

CONSERVATION SCORE SHEET

POPULATION:_____

1. Conservation of Number.

Subjects	Sex	Conserves	Does Not Conserve
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

2. Conservation of Solid Amount.

Subjects	Sex	Conserves	Does Not Conserve
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

3. Conservation of Liquid Amount.

Subjects	Sex	Conserves	Does Not Conserve
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

4. Conservation of Weight.

Subjects	Sex	Conserves	Does Not Conserve
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

5. Conservation of Length.

Subjects	Sex	Conserves	Does Not Conserve
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

6. Conservation of Area.

Subjects	Sex	Conserves	Does Not Conserve
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

APPENDIX C

DATA CODING METHOD

DATA CODING METHOD

Variable Codes	Card Column
Student I.D.	1 - 2
1 - 90	
Race	4
1 - Indian	
2 - Black	
3 - White	
Area	6
1 - Urban	
2 - Suburban	
3 - Rural	
Sex	
1 - Male	8
2 - Female	
Age	10 - 13
1 - 5.6 to 6.1	
2 - 6.1 to 6.8	
3 - 6.8 to 7.3	
Task 1 (1 - Conserves; 0 - Non Conserves)	15
Task 2 (1 - Conserves; 0 - Non Conserves)	16
Task 3 (1 - Conserves; 0 - Non Conserves)	17
Task 4 (1 - Conserves; 0 - Non Conserves)	18
Task 5 (1 - Conserves; 0 - Non Conserves)	19
Task 6 (1 - Conserves; 0 - Non Conserves)	20
Grand total number of conserving tasks	21

APPENDIX D

LIST OF TABLES AND GRAPHS

TABLE 1

MEAN ($\bar{X}$) AND STANDARD DEVIATION (SD) OF GRAND TOTAL CONSERVATION SCORES, AREA BY RACE

	Urban	Suburban	Rural
Indian	$\bar{X}$ = 2.5	$\bar{X}$ = 2.0	$\bar{X}$ = 0.6
	SD = 2.0	SD = 1.7	SD = 0.7
Black	$\bar{X}$ = 1.1	$\bar{X}$ = 1.2	$\bar{X}$ = 1.3
	SD = 1.2	SD = 1.1	SD = 1.0
White	$\bar{X}$ = 0.8	$\bar{X}$ = 2.0	$\bar{X}$ = 1.6
	SD = 1.0	SD = 1.9	SD = 1.7

TABLE 1.1

MEANS AND STANDARD DEVIATIONS OF
AREA, RACE, AGE, AND SEX

	Area	
Group 1 - Urban	$\bar{X}$ = 1.4	SD = 1.6
Group 2 - Suburban	$\bar{X}$ = 1.7	SD = 1.6
Group 3 - Rural	$\bar{X}$ = 1.2	SD = 1.3
	Race	
Group 1 - Indian	$\bar{X}$ = 1.70	SD = 1.7
Group 2 - Black	$\bar{X}$ = 1.2	SD = 1.1
Group 3 - White	$\bar{X}$ = 1.4	SD = 1.6
	Age	
Group 1 - 5.6 to 6.1	$\bar{X}$ = 1.0	SD = 1.2
Group 2 - 6.1 to 6.8	$\bar{X}$ = 1.2	SD = 1.3
Group 3 - 6.8 to 7.3	$\bar{X}$ = 1.9	SD = 1.7
	Sex	
Group 1 - Male	$\bar{X}$ = 1.3	SD = 1.4
Group 2 - Female	$\bar{X}$ = 1.5	SD = 1.6

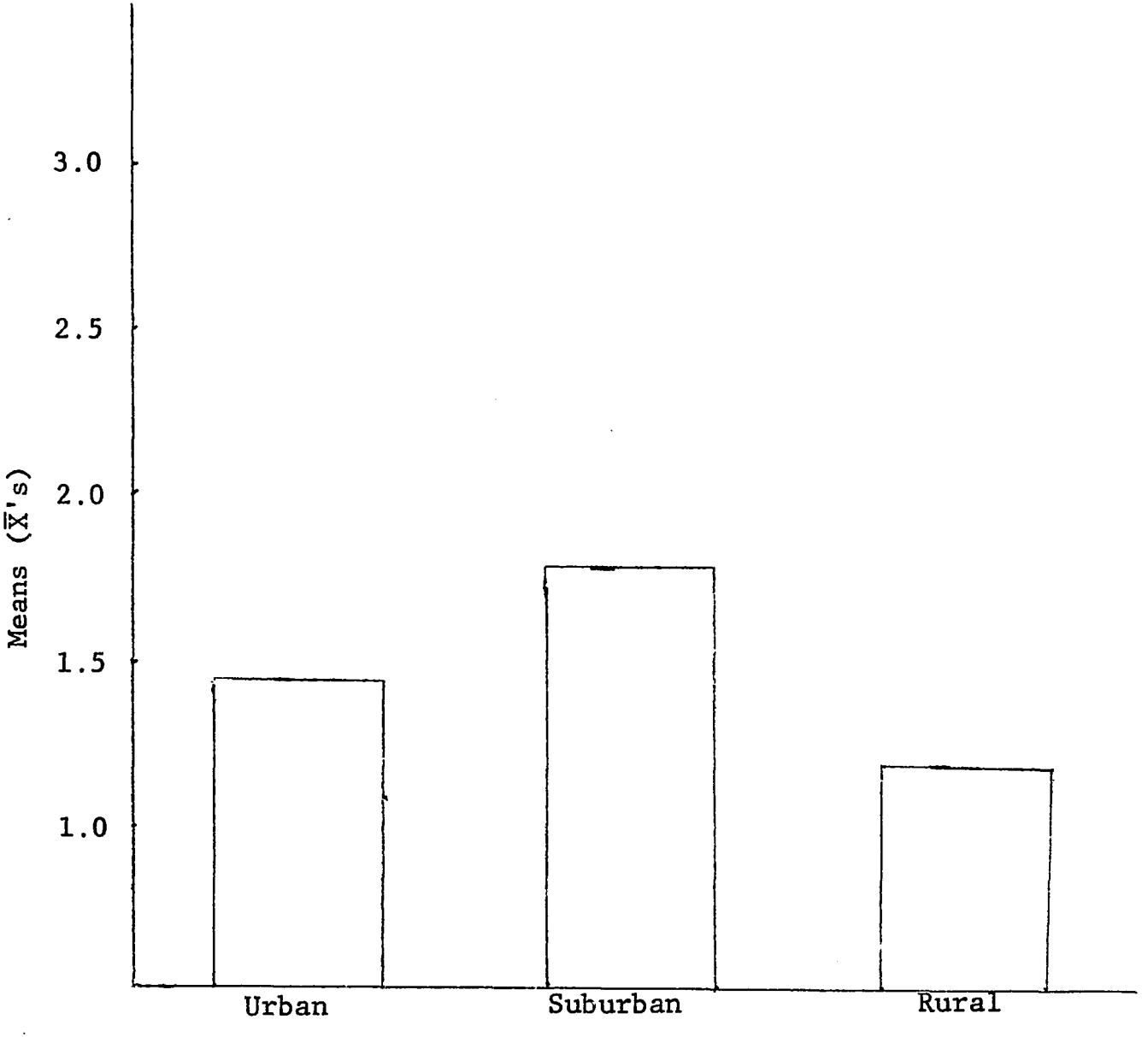

Figure 1. Main effect of area.

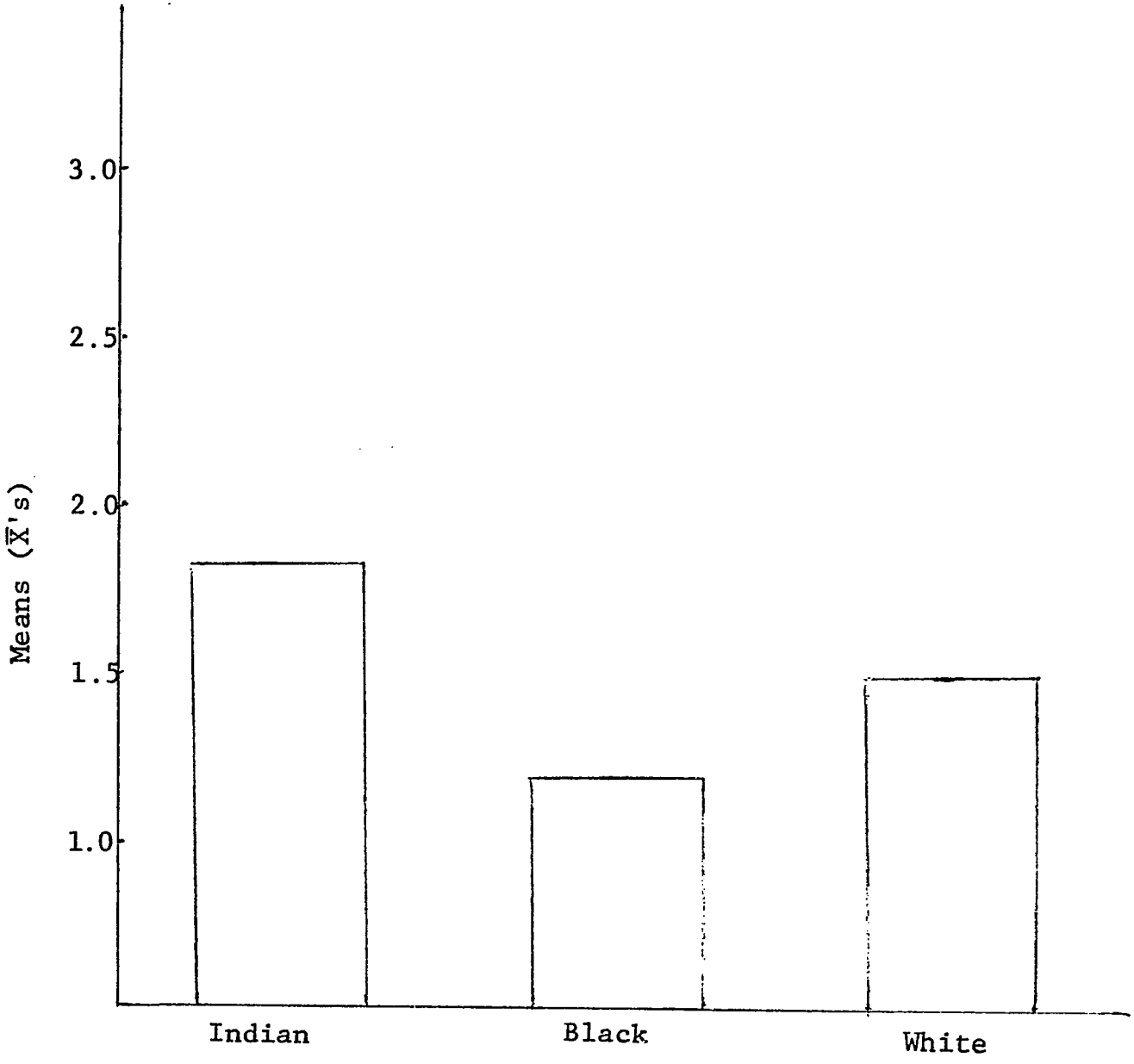

Figure 2. Main effect of race.

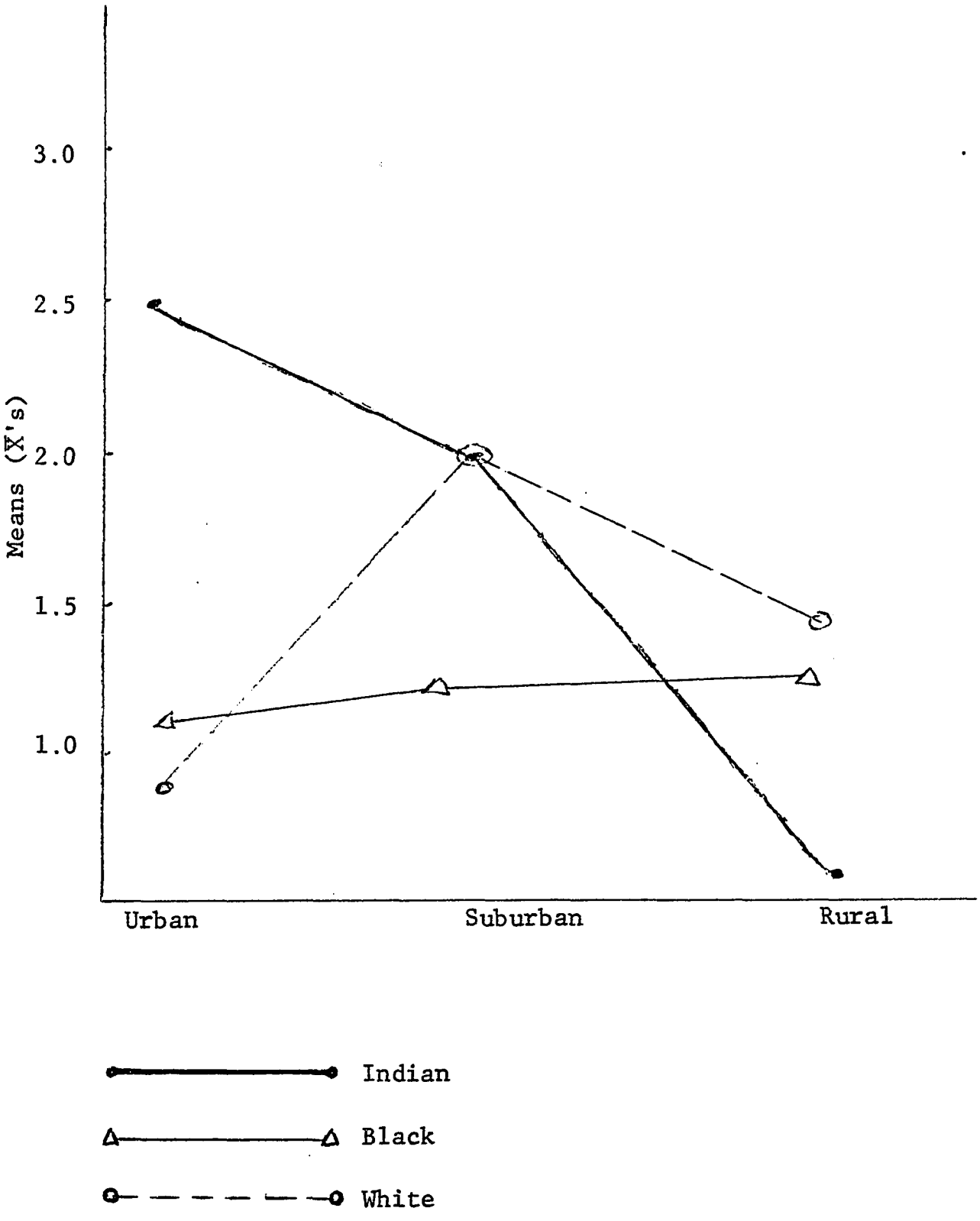

Figure 3. Graph of mean scores of area by race.

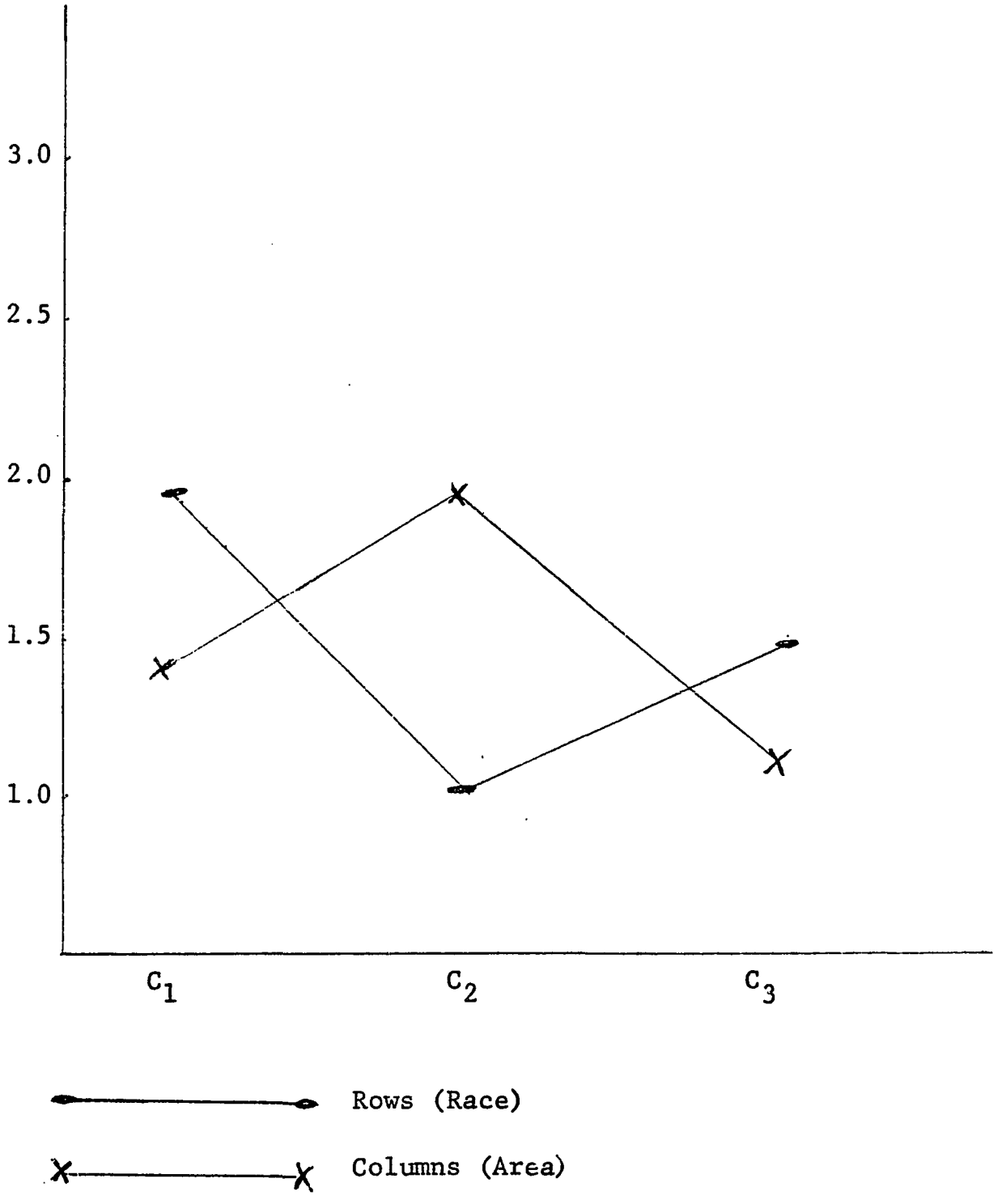

Figure 4. Graph of two-way ANOVA.